1,155,115

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,155,115

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COMPLETE SPECIFICATION

Improvements in or relating to Vehicle Heat Engine Cooling Systems and to Methods Of Regulating The Circulation Of Cooling Liquid In Such Systems

We, SOCIETE ANONYME DES USINES CHAUSSON, a French Company, of 35, rue Malakoff, 92 Asnieres, Hauts-de-Seine, France, do hereby declare the invention for which we pray that a Patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

In liquid cooling systems of heat engines of vehicles, the cooling liquid circulation is controlled and regulated by a thermostat placed between the engine and a cooling radiator.

It is known that the cooling liquid must be brought to an optimum temperature as quickly as possible, and kept at this optimum temperature value for proper running and long life of the engine.

Moreover, in modern vehicles, the air inside the vehicle is heated by using the liquid of the cooling circuit of the engine as a heat source, and consequently, it is advisable to hold this liquid at a fairly high temperature when running the engine in winter to obtain the best possible air heating, even for very low air temperatures outside the vehicle.

The present Applicant has already applied improvements to a cooling system, whereby a thermostat can be regulated in two different ways so that the cooling liquid such as water in the engine is kept, when running the engine in summer, at a lower temperature than when running in winter.

It has been noted that regulating the flow of cold cooling liquid to the engine by thermostat has drawbacks, especially when the air temperature outside the vehicle is very cold. Actually at an external air temperature of 20°C with the thermostat being regulated to open at 80°C, it often happens that the cooling liquid contained in the engine jackets is at about 90°C before the thermostat opens, for the thermostat is often placed nearer to the cooling radiator so that the cooling liquid coming from the engine drops in temperature before reaching the thermostat. Moreover, the sensitive part of the thermostat is immersed in a volume of the cooling liquid which is not in circulation as long as the valve controlled by the thermostat has not been opened, so that there is always a difference of at least 10°C between the temperature of the cooling liquid in which the sensitive part of the thermostat is immersed and the temperature of the cooling liquid inside the jackets of the engine.

As a result, when the valve controlled by the thermostat is opened, the cooling liquid rapidly circulates in the vicinity of said sensitive part which is thus brought into contact with hotter and hotter liquid which causes a very considerable opening of the valve. It follows that a corresponding quantity of very cold cooling liquid is conveyed into the cooling jackets of the engine. At temperatures of 20°C outside and 90°C inside the jackets of the engine, there is thus a variation of 110°C which is abruptly applied to the jackets of the engine, at least in the bottom parts of the engine unit. This results in frequent breakdowns, which may go as far as cracking the engine unit.

It is therefore an object of the present invention to provide a method of regulating the circulation of cooling liquid according to which the possibility of very cold liquid being conveyed to the jackets of the engine is minimised, to minimise the risk of damage to the engine.

Accordingly the present invention provides a method of regulating the circulation of a cooling liquid in a vehicle heat engine cooling system having a main or cooling radiator, an auxiliary or air heater radiator

and cooling liquid distributor means, in which with the engine running a small quantity of the cooling liquid is made to circulate, whenever the temperature of the liquid coming from the engine is less than a predetermined first threshold temperature, from the engine to a thermostatic element sensitive to the temperature of this liquid, in which said distributor means is caused by the element to open at said first threshold temperature, a first circuit of the cooling system enabling a larger quantity of the cooling liquid to circulate from the engine through a first part only of the cooling radiator until a second threshold temperature, higher than the first, is reached in the liquid coming from the engine, whereupon the distributor means is caused by the element to open a second circuit of the cooling system, enabling liquid to circulate also through the remaining part of the cooling radiator, and in which control means, connected to said element and to said distributor means, is selectively operable to open a third circuit of the cooling system, containing the air heater radiator, to liquid coming from the engine and at the same time to modify said threshold temperatures.

According to another aspect of the invention there is provided a vehicle heat engine cooling system including a main or cooling radiator, an auxiliary or air heater radiator and cooling liquid distributor means, wherein the distributor means includes a thermostatic element, means for ensuring that a small quantity of cooling liquid circulates from the engine to the thermostatic element when the engine is running and the temperature of the cooling liquid is below a first threshold temperature, first valve means for controlling flow of cooling liquid from the engine *via* the thermostatic element to a first part of the main or cooling radiator, and second valve means for controlling flow of cooling liquid from the engine *via* the thermostatic element to a second or remaining part of the main or cooling radiator, the first and second valve means being operative by the thermostatic element such that, in operation, the first valve means is opened at said first threshold temperature to allow a larger quantity of cooling liquid than said small quantity thereof to circulate, and the second valve means is opened at a second threshold temperature higher than the first to allow cooling liquid to flow through the second or remaining part of the main or cooling radiator, there being control means selectively operable to control by a third valve means flow of cooling liquid from the engine through the auxiliary or air heater radiator and at the same time to modify said threshold temperatures.

For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:—

Figure 1 is a diagram showing cooling liquid flow, according to the method of the invention of regulating the circulation of cooling liquid, in a vehicle heat engine cooling system, of the invention,

Figure 2 is a diagrammatic part longitudinal section of a cooling liquid distributor means for use with the method of the invention,

Figures 3 to 8 are diagrammatic part longitudinal sections similar to Figure 2 but on a smaller scale, showing characteristic operative positions of components of the distributor means of Figure 2,

Figure 9 is a diagram showing cooling liquid flow in an alternative cooling system to that of Figure 1, and

Figure 10 is a diagrammatic representation of a modification of the distributor means of Figure 2.

Referring now to the drawings in Figure 1 there is shown a heat engine 1 of a vehicle, and a cooling system therefor. The cooling system includes a cooling liquid pump 2 driven by this engine, which circulates cooling liquid such as water in the system, a main or cooling radiator 3, an auxiliary or air heater radiator 4, and a cooling liquid distributor means generally referenced 5.

The cooling radiator 3 is divided, for example, by a partition 7 in its upper header tank 6, so that its core is separated into two distinct parts 8 and 9, with the first part 8 including the minor section of the tank 6 and only some of the tubes of the core, and the second part 9 including the major section of the tank 6 and the remaining greater number of the core tubes.

The cooling liquid distributor means 5 includes manually operable mechanical control means 10 operable to regulate the passage of the cooling liquid, which is conveyed from the engine 1 to an inlet 12 of a first compartment of the distributor means 5 through piping 11, from the first compartment to a third compartment of the distributor means opening through an outlet duct 13 and piping 14 to the radiator 4 contained in a third cooling circuit of the system. The air heater radiator 4 is connected, moreover, in a manner known in itself, by a pipe 4*a* to the inlet of the pump 2. The distributor means 5 operates according to the temperature of the cooling liquid brought into its first compartment from the engine by the piping 11, so as first to allow circulation of only a very small quantity of the cooling liquid, when the temperature of cooling liquid coming from the engine is less than a first threshold

temperature, then to allow a larger quantity of the cooling liquid than said small quantity to circulate through a primary outlet 15 of the distributor means and via a first cooling circuit including piping 16 to the first part 8 of the radiator 3 when the liquid temperature rises above the first threshold temperature and finally when the liquid temperature reaches a second threshold temperature to allow cooling liquid also to pass through a secondary outlet of the distributor means 5 to a second cooling circuit including piping 18 and the second part 9 of the cooling radiator 3.

The first threshold temperature value and the second threshold temperature value are variable by means of the control means 10. These temperatures are variable so that the greater amount of cooling liquid fed through the outlet 13, the higher are the threshold temperatures so that a progressively higher liquid temperature is maintained in the engine 1 as the air temperature outside the vehicle falls.

The control means 10 ensures that when operated to stop cooling liquid flowing to the air heater radiator 4 in the third cooling circuit the cooling liquid in the engine is raised to a temperature of for example, 40°C, and when operated to open the third cooling circuit to the cooling liquid, the liquid in the engine is raised to a first threshold temperature of for example 70°C before said liquid is conveyed through the primary outlet 15 to the first part 8 of the cooling radiator 3.

The cooling liquid conveyed into the first part 8 of the radiator 3 causes the cooling liquid contained in the lower header tank 6*a* to circulate, mixing with and heating the liquid in the tank 6*a* before the latter is introduced by the pump 2 into the engine 1. It thus follows that very cold liquid cannot be circulated to the engine 1.

When the second threshold temperature is reached, which may be for example, at 70°C when the third cooling circuit is closed and at 85°C when the third cooling circuit is open, cooling liquid passes from the distributor means 5 through the secondary outlet 17 also and thus through the second part 9 of the radiator 3 in which this liquid is energetically cooled. Cooling liquid circulation through the first part 8 of the radiator 3 ensures that the very cold liquid in the second part 9 of this radiator, is mixed with the hot cooling liquid already circulating in the lower heater tank 6*a*. The liquid that has passed through the second part 9 of the radiator 3 is thus preheated in the tank 6*a* so that very cold liquid is not conveyed to the engine 1 through the pipe 19 connecting the lower header tank 6*a* to the inlet of the pump 2.

The cooling liquid distributor means 5 shown in Figure 2 has a casing 20 formed with a first compartment having the inlet 12 for receiving the liquid coming from the engine 1, a second compartment having the primary outlet 15 leading to the first part 8 of the radiator 3, a third compartment having the outlet 13 leading to the radiator 4, and the secondary outlet 17 leading to the second part 9 of the radiator 3. Internally, the casing 1 contains a thermostatic element 21, of bellows type, for example, housed in the first compartment. One end of the element 21 is rigidly connected to a movable portion of a first valve means that is to a stem 22 of a valve 23 cooperating with a seating 24 integral with the casing 20. The stem 22 slides in a guide 25 supporting the seating 24 and the first valve means separates the first and second compartments in the casing 20.

Means in the form of a small hole 23*a* through the valve 23 provide a permanently open leakage path through the valve means to ensure the circulation of a small quantity of liquid through the outlet 15, when the third circuit containing the radiator 4 is closed and before the first threshold temperature is reached, so that the liquid, inside the distributor means, in which the element 21 is immersed is progressively raised to the temperature prevailing in the engine, which would not be the case if no circulation was set up, since in the latter case the liquid in which the element 21 is immersed would be then only heated by convection currents, and hence, slowly, and there would be a great temperature difference between the liquid portion in which the element 21 is immersed and the temperature of the liquid inside the engine.

The other end of the thermostatic element 21 is rigidly connected by a rod 26 to a third valve means housed in the third compartment. The third valve means has a diaphragm 27 with an annular nose portion 27*a* intended to cooperate in fluid tight manner with an apertured partition 28 separating the first and third compartments in the casing 20.

The diaphragm 27 is actuated by the mechanical control means 10 which comprises, for example, a stem 29 connected to the diaphragm 27 and the rod 26 connecting the diaphragm 27 to the thermostatic element 21. This stem 29 is actuable by a lever 30 hinged in a fork 31 carried by a cover 32 closing one end of the casing 20. The distributor means 5 also includes a second valve means separating the second compartment from the secondary outlet 15. The second valve means has a valve 35, a guide 33 for a stem 34 of the valve 35, and a seating 36 against which the valve 35 is held by resilient biassing means in the

form of a spring 37.

The stem 34 is aligned with the stem 22 of the first valve means and the end of the stem 34 is separated from the corresponding end of the stem 22 of the valve 23 by a space 38 which is determined as a function of the extent to which the thermostatic element 21 should expand between the first and second threshold temperatures referred to before.

Figures 3 to 5 show the distributor means 5 in the three characteristic operative positions taken up when the method of the invention for regulating the flow of the cooling liquid in the cooling system is being carried out with cooling liquid circulation through the radiator 4 being prevented, that is when the mechanical control means 10 is operated so that the nose 27*a* of the diaphragm 27 presses fluid tightly against the partition 28 around the aperture therethrough. The circulation direction is shown by arrows in the Figures.

In Figure 3, the first threshold temperature has not yet been reached, so that the valve 23 is closed, the cooling liquid progressively heats in the engine 1, and only a very small quantity of cooling liquid can pass through the hole 23*a* to enable the thermostatic element 21 to be heated by cooling liquid coming from the engine.

In Figure 4, the first threshold temperature has just been exceeded, with the result that the thermostatic element 21 is sufficiently expanded to cause the valve 23 to open, and the cooling liquid is thus conveyed through the primary outlet 15 towards the first part 8 of the radiator 3.

In Figure 5, the second threshold temperature has been exceeded, with the result that the stem 22 of the valve 23 which is open has displaced the stem 34 of the valve 35 to open the latter, so that the cooling liquid can thus pass through the outlet 15 to the first part of the radiator 3 and through the outlet 17 to the second part 9 of the radiator 3.

Figures 6 to 8 show the distributor means 5 in similar characteristic operative positions to Figures 3 to 5 but in this case when the mechanical control means 10 has been actuated so that cooling liquid circulates through the air heater radiator 4. Again the circulation direction is shown by arrows in the Figures.

As can be seen in Figure 6, the diaphragm 27 is drawn back from the apertured partition 28 and the cooling liquid can thus pass through the outlet 13 to the radiator 4. In this case, the thermostatic element 21 has been stretched by displacement of the rod 26 connected to the actuating stem 29 of the mechanical control means 10. It follows that the thermostatic element 21 must now be expanded more than is the case in Figure 3, to cause the opening of the valve 23. Thus Figure 6 shows cooling liquid circulation for temperatures below the first threshold temperature.

It is by this means that the threshold temperatures are altered as hereinbefore described.

Figure 7 shows how circulation of the cooling liquid is set up when the first threshold temperature is exceeded. The cooling liquid passes through the outlet 13 to the air heater radiator 4, and through the primary outlet 15, to the first part 8 of the radiator 3.

Figure 8 shows the distributor means 5 after the second threshold temperature has been exceeded with the liquid being able to pass to the radiator 4 through the outlet 13, through the primary outlet 15 to the first part 8 of the radiator 3, and through the outlet 17 to the second part 9 of the radiator 3.

It should be noted that the mechanical control means 10 enables the quantity of cooling liquid fed to the radiator 4 to be varied by putting the diaphragm 27 into positions intermediate to those shown in Figures 3 to 8. These intermediate positions also give rise to different threshold temperatures at which the valves 23 and 35 are lifted from their seatings.

Figure 9 shows an arrangement in which the primary outlet 15 of the distributor means 5 is not connected to the upper header tank 6 of the radiator 3, but only to the lower header tank 6*a* at a point on the latter opposite to the point to which the pipe 19 leading to the pump 2 is connected. In this way, it is no longer necessary to partition the upper header tank 6, and a cooling liquid circulation is set up in the lower header tank 6*a* to prevent very cold liquid from being conveyed to the engine.

The modified distributor means shown in Figure 10 enables the pipes connecting the primary and secondary outlets 15 and 17 with the radiator 3 to be eliminated. This enables a substantial saving to be effected.

As shown by Figure 10, the casing 20 of the distributor means is partially housed inside the minor section of the upper header tank 6 of the radiator 3. The header tank 6 is provided with the partition 7 which is apertured to carry the valve 35 which projects therefrom into the major section of the tank 6.

The casing 20 of the distributor means of Figure 10 is not provided with a single outlet 15, but instead has outlet slots 20*a*, made in the part of the casing wall between the valve 23 and the valve 35. In this manner, when the valve 23 is moved from its seating by the thermostatic element 21, the liquid enters directly into the first part 8 of the radiator 3, and then, when the

valve 35 is opened, the liquid is conducted directly into the second part 9 of the radiator 3 to produce the same effect as previously described.

The distributor means may be made of metal parts or may be made of plastic especially by injection moulding, which would have the effect of reducing the number of parts, and assembly operations, thus enabling a reduction in cost price.

The thermostatic element 21 can be of any suitable type, for example, the diaphragm type, or the wax type. It can also be in the form of two thermostatic capsules, one ensuring low temperature regulation and the other, high temperature regulation. Utilisation of thermostatic capsules of the bellows type is often preferred, for in the case of one of them breaking, the valves 23, 35 can be arranged to be automatically opened, thereby forming a safety device.

WHAT WE CLAIM IS:—

1. A method of regulating the circulation of a cooling liquid in a vehicle heat engine cooling system having a main or cooling radiator, an auxiliary or air heater radiator and cooling liquid distributor means, in which with the engine running a small quantity of the cooling liquid is made to circulate, whenever the temperature of the liquid coming from the engine is less than a predetermined first threshold temperature, from the engine to a thermostatic element sensitive to the temperature of this liquid, in which said distributor means is caused by the element to open at said first threshold temperature, a first circuit of the cooling system enabling a larger quantity of the cooling liquid to circulate from the engine through a first part only of the cooling radiator until a second threshold temperature, higher than the first, is reached in the liquid coming from the engine, whereupon the distributor means is caused by the element to open a second circuit of the system enabling liquid to circulate also through the remaining part of the cooling radiator, and in which control means connected to said element and to said distributor means, is selectively operable to open a third circuit of the cooling system, containing the air heater radiator, to liquid coming from the engine, and at the same time to modify said threshold temperatures.

2. A method according to claim 1, in which said small quantity of cooling liquid circulates from the engine to said element via said first circuit throug a permanently open leakage aperture in said first circuit to ensure that the thermostatic element is always bathed by circulating cooling liquid during operation of the engine at cooling liquid temperatures below said first threshold temperature.

3. A method according to claim 1 or claim 2, in which a circulation of cooling liquid from the engine is set up, when the first circuit is open, through said one part of the cooling radiator comprising a portion of an upper header tank of the cooling radiator some of the cooling tubes of said cooling radiator, and the whole of a lower header tank of said cooling radiator.

4. A method according to claim 1 or claim 2, in which cooling liquid is circulated, when the first circuit is open, through said one part of the cooling radiator comprising a lower header tank of said cooling radiator.

5. A vehicle heat engine cooling system including a main or cooling radiator, an auxiliary or air heater radiator and cooling liquid distributor means, wherein the distributor means includes a thermostatic element, means for ensuring that a small quantity of cooling liquid circulates from the engine to the thermostatic element when the engine is running and the temperature of the cooling liquid is below a first threshold temperature, first valve means for controlling flow of cooling liquid from the engine *via* the thermostatic element to a first part of the main or cooling radiator, and second valve means for controlling flow of cooling liquid from the engine *via* the thermostatic element to a second or remaining part of the main or cooling radiator, the first and second valve means being operative by the thermostatic element, such that, in operation, the first valve means is opened at said first threshold temperature to allow a larger quantity of cooling liquid than said small quantity thereof to circulate, and the second valve means is opened at a second threshold temperature higher than the first to allow cooling liquid to flow through the second or remaining part of the main or cooling radiator, there being control means selectively operable to control by a third valve means flow of cooling liquid from the engine through the auxiliary or air heater radiator and at the same time to modify said threshold temperatures.

6. A cooling system as claimed in claim 5, wherein the thermostatic element is housed in a first compartment of the distributor means, which compartment is arranged to receive cooling liquid from the engine, and one end of the thermostatic element is rigidly connected to a movable portion of the first valve means operable by said element to regulate communication between the first compartment and a second compartment of the distributor means, which second compartment communicates with a first part of the main or cooling radiator, and wherein the second valve means controlling communication between

said second compartment and the second or remaining part of the cooling radiator is arranged so as to be openable, against resilient biassing means, by said movable portion of the first valve means when said portion is sufficiently displaced by said element, the end of the element remote from said first valve means being rigidly connected to the third valve means which controls communication between the first compartment and the auxiliary or air-heater radiator.

7. A cooling system according to claim 6, wherein said means for ensuring the circulation of the small quantity of cooling liquid over the element when the engine is running and said first valve means is closed, is a permanently open leakage path through said first valve means.

8. A cooling system according to claim 7, wherein the cooling radiator comprises an upper header tank and a lower header tank interconnected by a plurality of tubes, which upper header tank is partitioned into a minor section and a major section, the first part of the cooling radiator including the minor section and a small number of said tubes and the second part of the cooling radiator including the major section and the remainder of said tubes.

9. A cooling system according to claim 8, wherein the second compartment of the distributor means is housed at least partially in the minor section of the cooling radiator upper header tank so that the second compartment communicates directly with the inside of said minor section, said second valve means being provided on said partition to control communication between said second compartment and said major section of the cooling radiator upper header tank.

10. A cooling system according to claim 6, wherein the cooling radiator has an upper header tank and a lower header tank interconnected by a plurality of tubes, said lower header tank which forms the first part of the cooling radiator being connected at one end to said second compartment and at the opposite end to a circulation pump connected to the engine.

11. A cooling system according to any one of claims 6 to 10, wherein said third valve means is a diaphragm valve and wherein said control means is a mechanical linkage arranged to operate said diaphragm valve and at the same time to act on said thermostatic element to modify the temperatures at which said element operates said first and second valve means.

12. A method of regulating the circulation of a cooling liquid in a vehicle heat engine cooling system substantially as hereinbefore described.

13. A vehicle heat engine cooling system substantially as hereinbefore described and as shown in Figures 1 to 8, Figures 2 to 8 as modified by Figure 9, or Figure 10 of the accompanying drawings.

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1,155,115 COMPLETE SPECIFICATION
3 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

Fig.1.

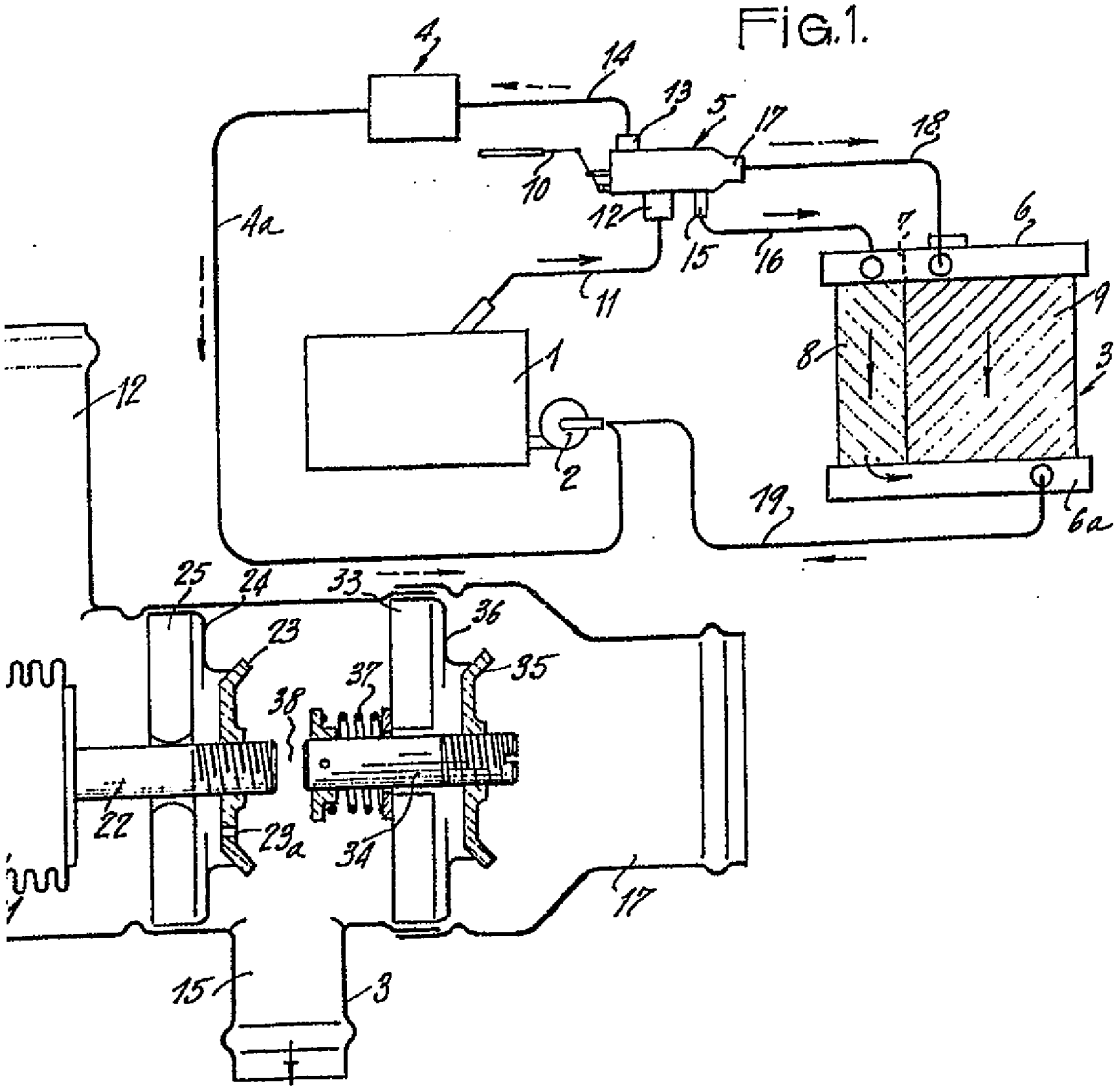
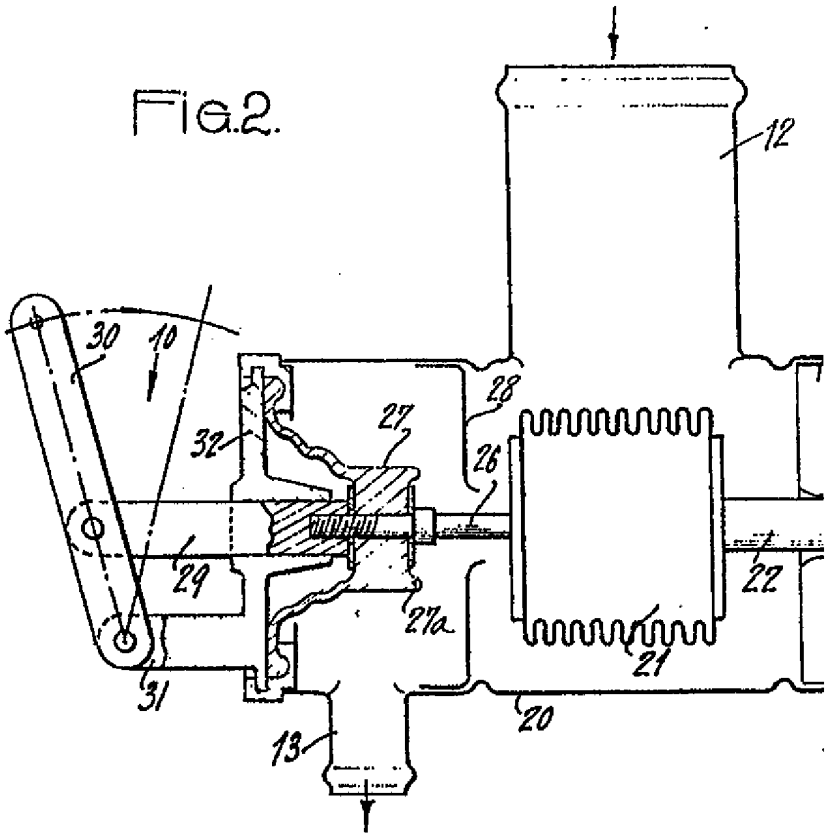


Fig.2.



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3 SHEETS

Fig.1.

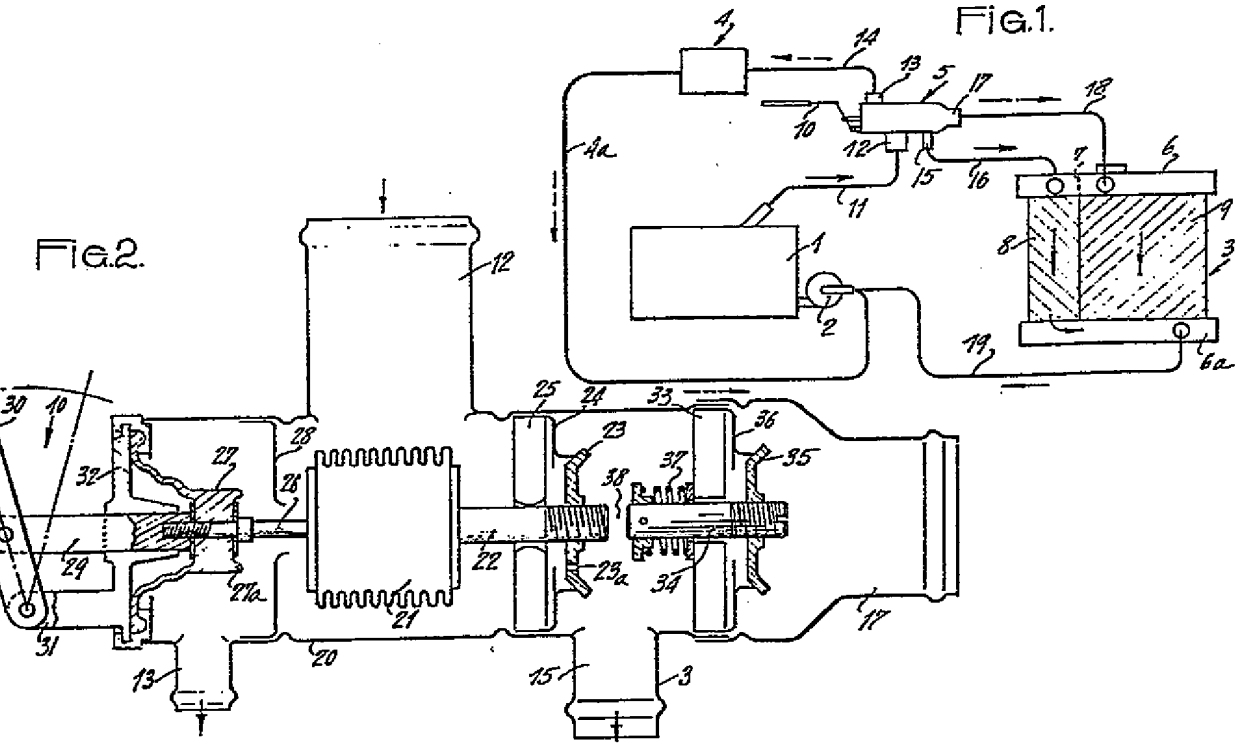

Fig.2.

Fig.3.

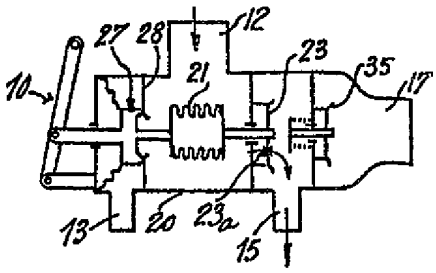

Fig.6.

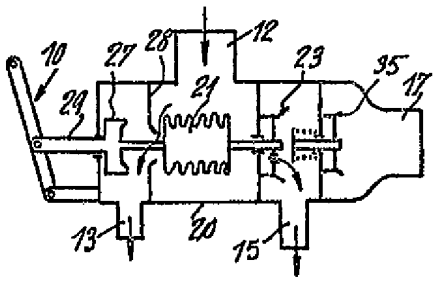

Fig.4.

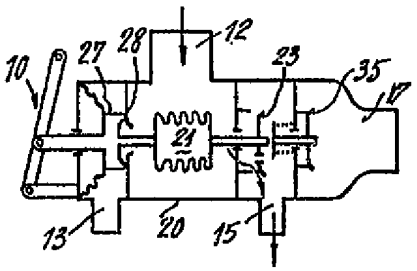

Fig.7.

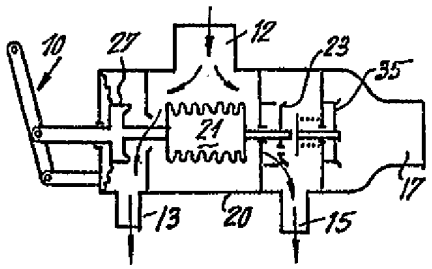

Fig.5

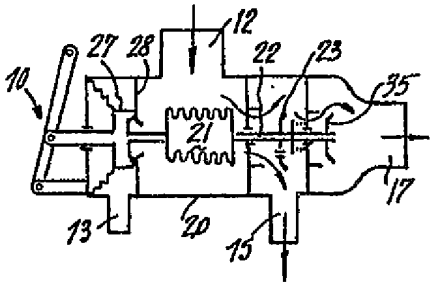

Fig.8.

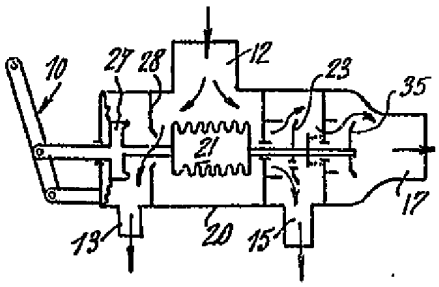

Fig.10.

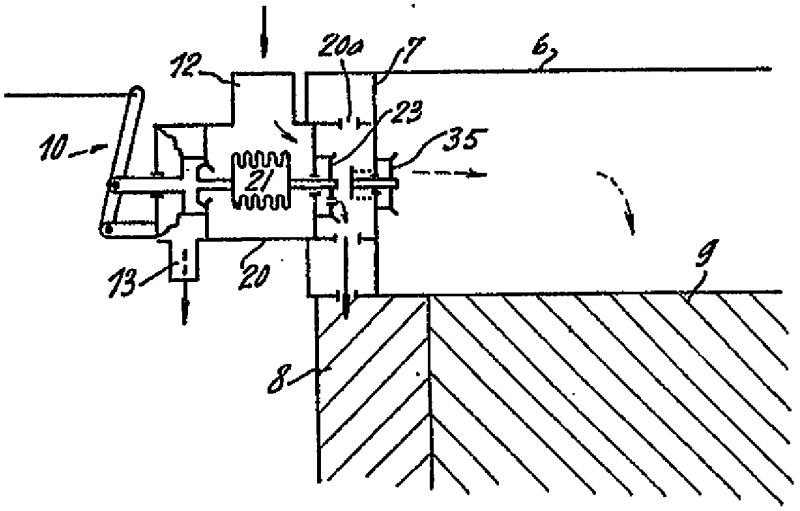
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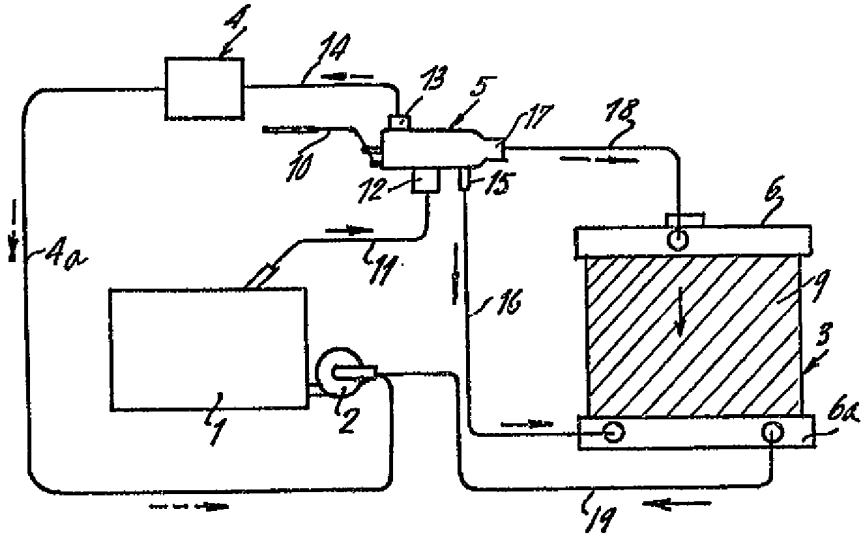
Fig.9.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